APPARATUS FOR FORMING THIN FILMS AND METHODS FOR FORMING CAPACITORS ON SEMICONDUCTOR SUBSTRATES USING SAME

Abstract of the Disclosure

Methods and apparatus for oxygen radical annealing or plasma annealing various layers (e.g., a lower electrode, a dielectric layer, or an upper electrode) of a microelectronic capacitor on a substrate are provided. By oxygen radical or plasma annealing the lower electrode of the capacitor, the leakage current characteristic of the capacitor may be improved such that the leakage current is reduced, for example, by a factor of 100 or more. The amount of impurities on the lower electrode may also be reduced. Oxygen radical or plasma annealing the dielectric layer of the capacitor may improve the leakage current characteristics of the capacitor and may reduce the amount of impurities in the dielectric layer. By ozone annealing the upper electrode, the leakage current characteristic of the capacitor may be improved and the number of oxygen vacancies formed in the dielectric layer may be reduced. An apparatus for forming a thin film on a substrate has a multi-functional chamber for depositing a dielectric layer on the substrate and an oxygen radical or plasma annealing unit connected to the multi-functional chamber. The oxygen radical or plasma annealing unit provides oxygen radical or plasma gas to the multi-functional chamber to oxygen radical or plasma anneal electrodes and/or dielectric layers on the substrate in the multi-functional chamber. Methods of using such apparatus are also provided.